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PATENT APPLN. NO. 10/766,487
RESPONSE UNDER 37 C.F.R. §1.111

NOV 13 2006

PATENT
NON-FINAL

REMARKS

Applicants note with appreciation the removal of the restriction requirement from the Action dated February 28, 2006, in the present application. As noted in the present Action, only the election of species requirement is maintained and claims 19 to 21 are withdrawn from present consideration.

The specification has been amended to identify information relating to the parent and priority applications of the present application.

Claims 1 to 12 and 17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite.

Regarding claim 1, the position of the Office is that it is unclear whether the recitation "miscible under such shear flow as caused by the shear rate kept in a range from of 100 to 10000 sec⁻¹" is a required process step or an inherent property. The recitation in claim 1 has been amended to read "which are miscible under a shear rate of 100 to 10000 sec⁻¹" in order to clarify that the recitation refers to an inherent property.

The Office is also taking the position that the recitations in claim 1 of "for making the resins miscible" and "for forming a continuous structure" are either unclear, grammatically incorrect or superfluous. In each of the recitations, the term "for" has

been deleted and replaced by the term "and" in order to phrase the recitations as positive process features.

Claims 3 to 5 have been canceled. Therefore, the rejection is moot as it pertains to claims 3 to 5.

Claims 11 and 17 are rejected on the basis that the dispersed structure of the claims is not permitted by the claims from which they depend, i.e., claims 10 and 16, respectively, which require a co-continuous structure. However, claims 10 and 16 both recite a co-continuous structure or a dispersed structure. Therefore, the recitation of "said co-continuous structure or dispersed structure" in claims 11 and 17 is supported by the claims from which they depend.

Additionally, the terminology "contained [used] as components" has been deleted from the claims, i.e., the claims have been amended as follows: "at least two resins ~~contained as components~~".

Removal of the 35 U.S.C. 112 rejections of the claims is believed to be in order and is respectfully requested.

Prior to discussing the prior art rejections of the claims, applicants note that claims 1, 2, 6, 9, 13 and 16 have been amended to limit a wavelength of concentration fluctuation or a distance between particles to a range of 0.001 to 0.5 μm . This range is supported by the description on page 10, line 28, to page 11, line

2, of the specification of the present application. Claims 1, 6, 9 and 13 have also been amended to limit the resins of the polymer alloy to certain combinations based on the description on page 14, line 25, to page 15, line 21, of the specification of the present application.

Claims 1, 2, 9 to 11, 13 and 14 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over DE 3803663 (hereinafter "DE '663"). Claims 1, 2, 6, 7, 9 to 11, 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over DE '663, optionally in view of Cottis et al., U.S. Patent No. 5,262,473, (hereinafter: "Cottis").

Applicants respectfully submit that DE '663 is insufficient to support a case of anticipation or obviousness over the claims of the present application. DE '663 discloses, as a resin, a combination of a non-rigid thermotropic polymer and a polycarbonate. DE '663 does not disclose any of the specified combination of resins recited in the amended claims.

Furthermore, the Office has not shown that DE '663 teaches spinodal decomposition as recited in claim 1 or the wavelength of concentration fluctuation/distance between particles as recited in independent claims 1, 6, 9 and 13. As discussed below in the remarks concerning Kyu (U.S. Patent No. 5,049,619), the

wavelength/distance limitation of the present claims is not an inherent property of the materials used as the two resins. Therefore, the Office has not shown that Meier teaches each and every element of the present application or, alternatively, that the combination of Meier and Cottis will result in the invention of the present application.

Claims 1, 2, 9 to 13 and 15 to 18 are rejected under 35 U.S.C. 103(a) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over the Okamoto article in *Polymer* #35 (2) (hereinafter: "Okamoto"). Claims 1, 2 and 6 to 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Okamoto, optionally in view of Nedzu et al. (U.S. Patent No. 5,108,806; hereinafter "Nedzu") or Scott (U.S. Patent No. 4,125,572).

Okamoto discloses wavelengths of the polymer alloy in Fig. 7 ($\lambda_{m,o}$ is the wavelength of fluctuations in the polymer alloy). Although the reference does not expressly identify the meaning of $\lambda_{m,o}$, Okamoto identifies the relationship between wavenumber and wavelength in equation (6) as $2\pi/q_m = \lambda_m$, wherein q_m represents the wavenumber of fluctuations. A person of ordinary skill in the art would recognize that $\lambda_{m,o}$ represents the wavelength of fluctuations based on equation (6). As shown in Fig. 7, white circles show the wavelength of PBT/PC polymer alloy to be in the range of 1.1 to 1.3

µm. This is outside the wavelength range of the claims of the present application as amended, i.e., 0.001 to 0.5 µm.

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Meier et al. (U.S. Patent No. 5,106,906; hereinafter "Meier"). Claims 3 to 6 are rejected as being unpatentable over Meier in combination with Nedzu.

The rejection as it applies to claims 3 to 5 is moot in view of the cancellation of the claims. Applicants respectfully submit that the combination of Meier and Nedzu is insufficient to support a case of obviousness of claim 6. Meier does not disclose and does not otherwise lead, or direct, a person of ordinary skill in the art to apply the mixing techniques disclosed therein to the specific combinations of polymers recited in claim 6. Meier discloses only a combination of PC and PMMA in the Examples section. A person of ordinary skill in the art could not reasonably predict the results of applying the mixing techniques of Meier to the combination of polymers disclosed in Nedzu.

Claims 13 and 14 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over Kyu (U.S. Patent No. 5,049,619; hereinafter "Kyu '619").

In this rejection, the Office alleges that the concentration fluctuation/distance between particle limitations are inherently met by Kyu since both Kyu and the present application disclose spinodal decomposition from a single phase blend.

Applicants respectfully submit that the polymer of Kyu does not inherently have the same concentration fluctuation/distance between particles recited in the present claims, particularly as amended. Attached to this response is a copy of "Kinetics of Phase Separation by Spinodal Decomposition in PC/PMMA Blends" by Kyu (from *Polymer Preprints*, 1987, 28(2), pp. 124 - 125). The experiments reported in the article were performed in the same manner as those of Kyu '619. Although Kyu '619 does not disclose wavelength, the attached document discloses wavenumber (q_m) in Fig. 4 (y-axis). According to Fig. 4, wavenumber (q_m) in the experiments of Kyu has a maximum value of about $6\mu\text{m}^{-1}$. Using equation (6) from Okamoto ($2\pi/q_m = \lambda_m$) wavelength in Kyu is calculated to be about 1.0 μm at a minimum. This is outside the wavelength range of the claims 13 and 14 as amended, i.e., 0.001 to 0.5 μm .

Removal of the 35 U.S.C. 102(b) and 35 U.S.C. 103(a) rejections of the claims is believed to be in order and is respectfully requested.

Claims 1 to 18 are provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 1 to 18 of copending application Serial No. 10/732,803. Removal of the rejection under 35 U.S.C. 101 is in order in view of the abandonment of application Serial No. 10/732,803. The present application is a continuation-in-part of 10/732,803.

Claims 1 to 18 are provisionally rejected on the ground of non-statutory obviousness-type double patenting ("ODP") as being unpatentable over claims 1 to 15 of copending application Serial No. 11/020,564. Without admitting the propriety of the ODP rejection, applicants respectfully request that the ODP rejection be held in abeyance pending the determination of allowable subject matter in the present application. If only an ODP rejection remains in an application, the Office should withdraw the rejection if the application has the earliest filing date.

The foregoing is believed to be a complete and proper response to the Office Action dated May 11, 2006, and is believed to place this application in condition for allowance. If, however, minor issues remain that can be resolved by means of a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number indicated below.

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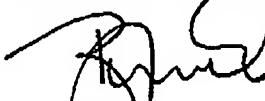
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In the event that this paper is not considered to be timely filed, applicants hereby petition for an appropriate extension of time. The fee for any such extension may be charged to our Deposit Account No. 111833.

In the event any additional fees are required, please also charge our Deposit Account No. 111833.

Respectfully submitted,

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Attachment: Kyu, Thein et al., "Kinetics of Phase Separation by Spinodal Decomposition in PC/PMMA Blends", *Polymer Preprints*, 1987, 28(2), pp. 124 - 125.

KINETICS OF PHASE SEPARATION BY SPINODAL DECOMPOSITION IN PC/PMMA BLENDS

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INTRODUCTION

In conjunction with recent advances in time-resolved scattering techniques, the dynamics of polymer phase separation has made considerable progress¹⁻⁴. Polymer phase separation has been known to occur through the nucleation and growth (NG) or the spinodal decomposition (SD). The former is the rare occurrence which is stable at small composition fluctuations but is unstable at sufficiently large fluctuations. The latter refers to a phase separation process extremely unstable at infinitesimal composition fluctuations. The early stages of SD may be interpreted in terms of the linear theories of Cahn and Hilliard⁵, Millert⁶, and Cook⁷, predicting the exponential growth of the scattered intensity. Newer theories have been introduced with a power law relation, typically the cluster theory of nucleation by Binder and Stauffer⁸ and a non-linear theory by Langer, Bar-on and Miller⁹. The late stage of SD has been proposed by Siggia¹⁰ in which the coarsening process occurs due to the coalescence of domains.

A limited number of experimental studies dealing with the kinetic aspects of polymer phase separation is available in the literature, notably on PS/PVME^{2,11}, PS/PMPs¹², and PS/PA oligomers³. The number of such studies continue to increase as can be witnessed in recent publications^{4,13}. The present study on the PC/PMMA system is a new addition to the above kinetic studies.

EXPERIMENTAL

Polycarbonate (Lexan 141, G.E.; $M_w \sim 58,000$, $M_w/M_n \sim 2.7$) and polymethyl methacrylate (V811, Rohm and Haas; $M_w \sim 84,000$, $M_w/M_n \sim 2.1$) were dissolved in a common solvent, tetrahydrofuran (THF) at a concentration of 2% by weight. Blend specimens were cast on glass slides at elevated temperatures (around 47°C) to obtain transparent single phase blends. Time-resolved light scattering experiments were conducted using a two-dimensional Vidicon camera coupled with an Optical Multichannel Analyser (OMAI) and an off-line computer for post data treatment.

RESULTS AND DISCUSSION

Differential scanning calorimetry (DSC) studies on the PC/PMMA blends cast at 47°C from THF reveal a single T_g for all compositions. In the subsequent runs after cooling from the melt state, the intermediate blends show distinct dual T_g , implying the occurrence of thermally induced phase separation in the system.

To confirm this, light scattering scans were acquired on the PC/PMMA (40/60) blend which was heated above 265°C. Figure 1 exhibits the two- and three-dimensional perspective plots of the scattering halo characterizing the polymer phase separation. A high level of interconnected domains can be observed in the optical microscopic investigation. Both observations are the familiar characteristics of spinodal decomposition. The phase diagram was subsequently established based on the cloud point measurements. Figure 2 shows the cloud point curves of the PC/PMMA system obtained at two different heating rates. The curves are rather flat for

polymeric mixtures, but resemble an LCST (lower critical solution temperature). Since PC and PMMA used in the present study are typical commercial grades, the polydispersity might affect the phase diagram. It should be pointed out that the cloud point phase diagram does not represent the equilibrium phase diagram, but is merely a rate-dependent one.

In an attempt to understand the kinetics of spinodal decomposition, time-resolved light scattering scans were obtained for the PC/PMMA (40/60) and (70/30). Figure 3 shows a set of typical time-evolution of scattering curves following a T-jump to 253°C. Several additional T-jump experiments were performed. In the early stages of SD the scattering maximum remains stationary for a short period during which the intensity increases exponentially. This is the kind of behavior predicted by the linearized Cahn-Hilliard theory⁵. In this regime, the size of the phase separated domains does not change, but the gradient of the composition fluctuation at the boundaries becomes larger.

In the late stages of SD, the scattering peak shifts to low scattering angles while the intensity continues to increase. The power law scheme seems to prevail in this region, i.e. the plots of $\log q_m$ versus $\log t$ and $\log I$ versus $\log t$ in Figure 4 appear linear which may be represented by the slopes of -1 and 3, respectively. These exponents are exactly the values predicted by Siggia¹⁰ for the coarsening process in that the cluster aggregates and coalesce into larger clusters by the diffusion process through interconnected channels. This coarsening mechanism is reminiscent of the percolation process and seems to be controlled by surface tension.

Similar observation was also made for the PC/PMMA (70/30) blends at large T-jumps with an exception that the very late stage of SD was detected. That is, the log-log plots of q_m vs t deviate from the slope -1, suggesting that the growth process slows down or the clusters are broken into smaller sizes. Physically, it is obvious that the growth process cannot continue indefinitely and at one point, it should slowdown or stop.

The scaling analysis was undertaken with the reduced variables $Q = t q_m$ and $\tau = D t^{2/3}$. Figure 5 shows such a reduced plot for the PC/PMMA (40/60) blends, manifesting that all the curves in Figure 4 can be scaled to a single master curve. This suggests that the mechanisms of SD at small and large temperature jumps are similar.

ACKNOWLEDGEMENT

The partial support from EPIC (Edison Polymer Innovation Corporation), is gratefully acknowledged.

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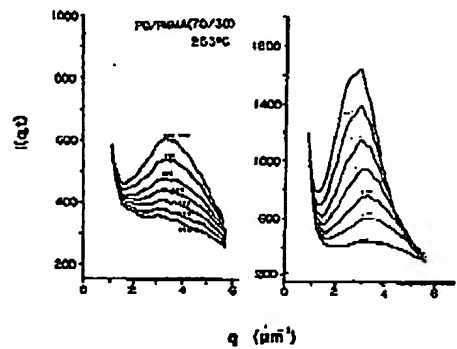


Fig. 3. Time-evolution of scattering curves of the 70/30 blends following a T-jump to 253°C.

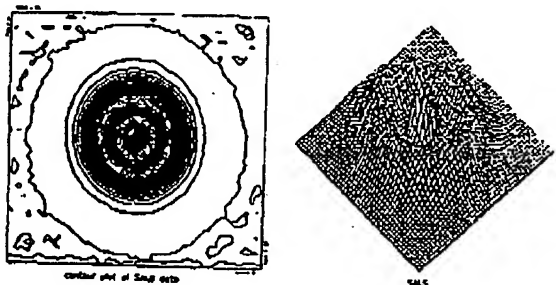


Fig. 1. Two and three dimensional isointensity contours of a scattering halo from the 40/60 (PC/PMMA) blend.

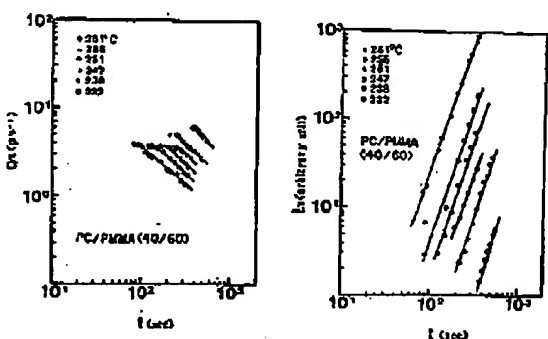


Fig. 4. Log-log plots of q_m vs t and I_m vs t for the 40/60 blends at various T-jumps.

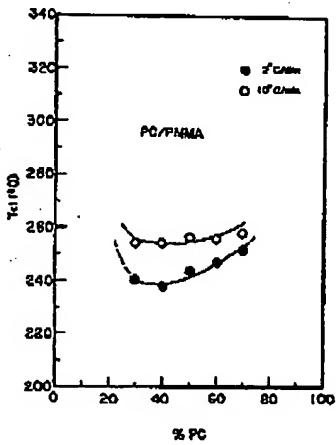


Fig. 2. The cloud point phase diagram of PC/PMMA blends.

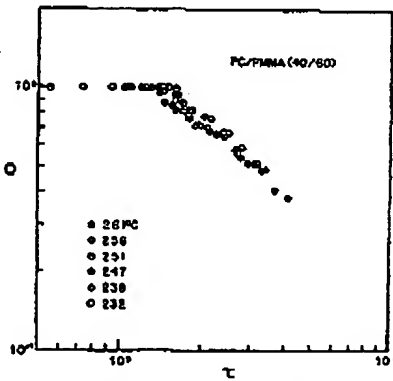


Fig. 5. A reduced plot of Q vs τ for the 40/60 blend.